# Solar Energy and Its Future Role in India and Iran

**Afsanehsadat Omidiani*, SeyedMohsen HashemiHezaveh****

* College Of Architecture, Bharati Vidyapeeth University, Pune
** Yashwantrao Mohite College, Bharati Vidyapeeth University, Pune

**Abstract-** There are various factors such as negative impacts on environment, increasing in fossil fuels prices, limitation of fossil fuel resources which have made many energy and environment experts and politicians move toward the development of a modern structure to secure supply of energy, environment protection. Therefore, most countries have begun to realize that the need for sustainability in energy production and consumption is significantly vital. Therefore, tracking the progress of sustainability is essential.

Solar Energy is a clean renewable resource with zero emission. Most of the developed countries are switching over to solar energy as one of the prime renewable energy source.

The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change. The study is motivated by the need to transform the basis of energy systems from fossil fuels to renewable sources.

Moreover, regarding the increasing rate of the population, solar energy can play a serious role in sustainability of environmental issues as a renewable energy.

The objective of present study is concentrate on role, situation and developing solar energy in India and Iran to recognize the Investment and Potential Opportunities in society and economic for achievements of sustainable energy.

**Keywords:** Solar Energy, fossil fuel resources, clean renewable resource, Iran, India.

## I. Introduction

Energy is the prime mover of economic growth, and is vital to sustaining a modern economy and society. Future economic growth significantly depends on the longterm availability of energy from sources that are affordable, accessible and secure. (ICLEI South Asia, 2007 ) .

A public concern over the environmental consequences of greenhouse gas emissions from fossil fuels, increasing trends in use of renewable energy sources became an important energy policy target in most parts of the world. Use of renewable energy sources can reduce the speed of global warming and serious impacts of climate change from burning fossil fuels. Renewable energy is derived from sources that are being replaced by nature, such as water, wind, solar or biomass (Hiremath, R.B., B. Kumar, P. Balachandra & et al, 2009). Renewable energy sources are the fastest growing energy source in the world and various projections indicate that these resources will have huge contribution in the future (Amer, M. and T.U. Daim, 2011; EIA, 2009; Jefferson, M., 2006).

The concept of sustainable development (SD) was adopted by the World Commission on Environment and Development. There is agreement that SD involves a comprehensive and integrated approach to economic, social and environmental processes (Karakosta, C. and D. Askounis, 2010; WCED-World Commission on Environment and Development, 1987). A sustainable development approach aims to deliver services that meet basic human needs, but in a cleaner and more efficient manner that can be sustained for long term (Winkler, H., 2007).

Greenhouse gases and CO2 have risen to the top of the list of the energy sector's environmental impacts, as the source of human-made climate change which the main CO2 emissions are because of the combustion of fossil fuels to provide energy in transportation sectors.

**Solar energy:**

Solar energy is the most abundant energy resource and it is available for use in its direct (solar radiation) and indirect (wind, biomass, hydro, ocean etc.) forms. About 60% of the total energy emitted by the sun reaches the Earth's surface. Even if only 0.1% of this energy could be converted at an efficiency of 10%, it would be four times larger than the total world's electricity generating capacity of about 5 000GW.

The use of solar energy is growing strongly around the world, in part due to the rapidly declining solar panel manufacturing costs (World Energy Council, 2013). Solar energy is cited as a clean alternative to fossil fuels. Solar panels generate energy without producing ambient pollution. It is a clean renewable energy and green energy source. The important advantage is related to the reduced CO2 emission and air pollution prevention to the environment, it is a method for producing energy which also has some economic benefit. Solar energy allows human to generate energy in cheap way. (Hafshejani, M. K., Baheri A., Ojakeh M. & et al, 2012)

Solar energy applications have the wide area. One of the most important areas is the generation of electrical power (Sukhatme S., 1997). Some of these applications are such as solar desalination using, solar heat, solar still method, solar water heating pipes and solar space heating and cooling (Badran O O., 2001).

**Methodology**

This study is conducted with qualitative method. Information is acquired through defining the advantages and limitations based on the overviews from solar energy along with literature review and investigate the related issues of solar energy and studied some cases of current solar energy in India and Iran and finally create a guideline toward solar energy.

**Qualitative Research**

Qualitative research is the most common approach for collecting raw data in explorative research projects, whereby\ researchers are either trying to identify a business problem/opportunity or simply collecting required information to obtain preliminary insights in an unexplored field of research. Moreover it is a tool to develop(Hair, Busch, & Ortinau, 2000).

The main advantage of qualitative research compared to quantitative research is that it is more economical and less time-consuming due to the reduced sample size used. Furthermore, detailed data on personal attitudes, emotions, perceptions and beliefs concerning the research topic can be collected and actual behavior can be investigated and recorded (Hair, Brush & Ortinau, 2000).

Whereas journals and articles was constituted the source for secondary data for the research.

## II. Research Elaborations:

**1.India's Scenario:**

India was the fourth-largest energy consumer in the world after China, the United States, and Russia in 2011, and its need for energy supply continues to climb as a result of the country's dynamic economic growth and modernization over the past several years.

Primary energy consumption in India has more than doubled between 1990 and 2012, reaching an estimated 32 quadrillion British thermal units (Btu). The country has the second-largest population in the world, at more than 1.2 billion people in 2012, growing about 1.3% each year since 2008, according to World Bank data. At the same time, India's per capita energy consumption is one-third of the global average, according to the International Energy Agency (IEA), indicating potentially higher energy demand in the long term as the country continues its path of economic development. In the International Energy Outlook 2013, EIA projects India and China will account for about half of global energy demand growth through 2040, with India's energy demand growing at 2.8% per year.

India's largest energy source is coal, followed by petroleum and traditional biomass and waste. Since the beginning of the New Economic Policy in 1991, India's population increasingly has moved to cities, and urban households have shifted away from traditional biomass and waste to other energy sources such as hydrocarbons, nuclear, biofuels, and other renewables. The power sector is the largest and fastest-growing area of energy

demand, rising from 22% to 36% of total energy consumption between 1990 and 2011, according to the IEA. India's National Sample Survey Organization estimates that about 25% of the population (over 300 million people) lack basic access to electricity, while electrified areas suffer from rolling electricity blackouts. The government seeks to balance the country's growing need for electricity with environmental concerns from the use of coal and other energy sources to produce that electricity. India's transportation sector, primarily fueled by petroleum products, is set to expand as the country focuses on improving road and railway transit. The government plans to mandate some alternative fuel use, particularly with biofuel blends, and develop greater use of mass transit systems to limit oil demand growth (U.S. Energy Information Administration, 2014).

The International Energy Agency (IEA) notes that India will become the single-largest source of global oil demand after 2020 (PTI, 2013). Crude oil imports are the biggest contributor to India's bloated current account deficit. The outlook for India's energy production seems stark as it is estimated the country will face a shortage of 6.7 percent in 2013-2014 (Lok Sabha, Unstarred Q., 2013). Southern India, consisting Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Puducherry, showed a combined economic growth rate of 7.85 percent in 2013. However, this trajectory would be negatively affected owing to a projected 20 percent shortage in electricity (Ibid). The primary reason for the electricity shortage is an over-reliance on thermal energy from coal and gas. Further, 100000 out of nearly 600000 (Lok Sabha, Unstarred Q., 2012) villages in India do not have access to electricity (Gevorg Sargsyan et al., 2011). Against this backdrop, renewable energy presents a more sustainable and financially sound option for the long term.

### 1.1. Solar Power Generation across States

India is blessed with the potential for a significant amount of solar energy generation. At 300 to 330 days of sun per year, the country plans to establish mega solar power plants to capitalize on this important domestic resource. As in many other sectors, India's states seek to drive change and attract investment in solar power, too (the top five states in solar power generation added in the last three years are shown in figure 1). MNRE has finalized plans to set up the world's largest solar power project in Rajasthan, with a capacity of 4000 MW. The first phase of the project is anticipated to be complete by 2016.( Press Information Bureau, Government of India: 2013). Land has already been located for a project in Gujarat. The government also plans to set up mega projects in Kargil and Ladakh with capacities of 2000 MW and 5000 MW respectively ( More ultra-mega solar plants on anvil", The Hindu, 2013).

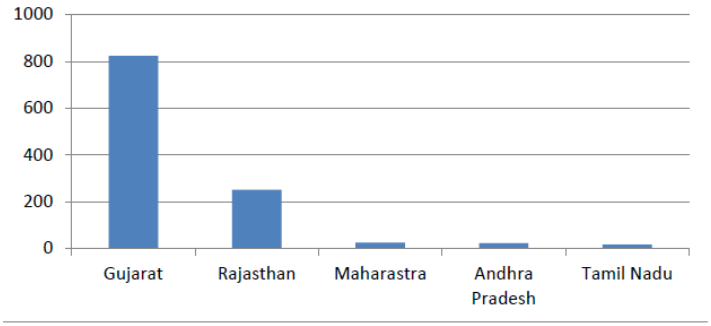


Figure 1: Top Five States in Solar Power Generation Capacity added in last 3 years (MW)

(Lok Sobha, Unstarred Q., 2013).

### 1.2. Solar sectors in India:

Prior to 2008, solar power generation in India was restricted to some off-grid applications generating a few hundred megawatts. Domestic manufacturing capacity was less than 200MW. However, the launch of the Jawaharlal Nehru National Solar Mission (NSM) in 2010 changed this situation. Together with the development of solar policies in some states, the NSM saw installed capacity in solar power rising to 2.18GW by the end of 2013. Given its relatively short lifespan, the solar sector remains small and immature compared with wind.

As well as diffusing both solar photovoltaic (PV) and solar thermal generation, the NSM was designed to create R&D capacity and promote domestic production of solar technologies. The aims of the Mission are tied quite closely to India's obligations under the United Nations Framework Convention on Climate Change (UNFCCC), and its launch has been closely associated with the prime minister's National Action Plan on

Climate Change (NAPCC). The MNRE is the lead ministry, though a number of other key ministries have been involved with establishing the NSM.

The NSM is focused in Rajasthan, the state with the greatest solar resources. Under a different policy regime, Gujarat has also developed significant state-level capacity. The overwhelming majority of installed solar capacity is therefore concentrated in these two states, as shown in Figure 2.

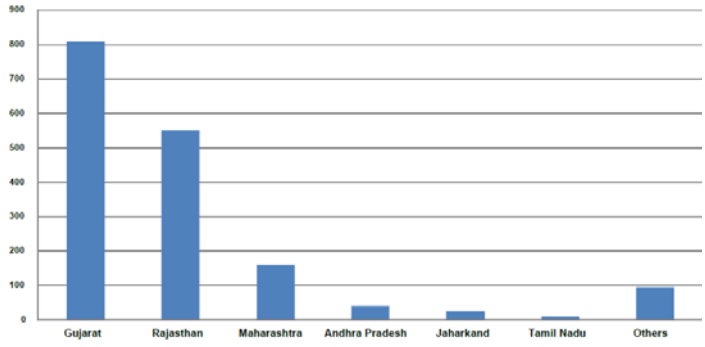


Figure 2. State-level installed solar capacity (MW)

*Source*: (Krishna *et al.*, 2014).

### 1.3. Role of Central and State Governments

India is the only country with a Ministry dedicated to New and Renewable Energy. There are nodal agencies in each State, which specifically work on enhancing the percentage of renewable energy in the power-mix. States such as Rajasthan, Karnataka, Maharashtra, Gujarat, and West Bengal have already taken initiatives for installation of large solar power plants. The MNRE also announced Generation Based Incentives (GBI) in 2008, to incentivize development of solar power plants(Sharma, 2011).

### 1.4. Ernst & Young LLP's Renewable Energy Country Attractiveness Index (RECAI)

India ranks nineth overall on Ernst and Young LLP's most recent renewables attractiveness index. Although the country's position has fallen on notch, India's ranking on the solar index has improved from fourth to third. According to the report, the macroeconomic outlook for India remains strong, and capacity forecasts for onshore wind and solar PV have increased for the four-year outlook period.

The Indian government has launched Jawaharlal Nehru National Solar Mission (JNNSM) with a target of achieving 20000 MW by 2022. The goal is to make India one of the leaders in solar energy. Although Solar energy is still expensive today, but costs are coming down with technology development, right governmental policies and R and D efforts (Ernst & Young LLP, 2013).

India has an expanding solar energy sector: 9 solar cell manufactures, 22 PV module manufactures, and 50 PV systems manufacturers. Therefore, technology resources exist in country and a growing market would lead to job growth in country.( Meisen, P., 2006 )

### 1.5. India and future:

**Jawaharlal Nehru National Solar Mission (JNNSM)**

The mission will be carried out in three phases and aims to do the following: to create a policy framework for deployment of 20,000 MW by 2022; to add 1,000 MW of grid solar power by 2013, and another 3,000 MW by 2017. The target for 2017 may be higher based on the availability of international finance and technology transfer.

The scheme also aims at strengthening indigenous manufacturing capability, and achieving 15 million sq. meters solar thermal collector area by 2017 and 20 million by 2022. One of the steps to achieve this will be to make solar heaters mandatory by incorporating byelaws in the National Building Code. Deployment of 20 million solar lighting systems for rural areas by 2022 is also part of the scheme. This mission has received widespread support from agencies like the World Bank and the Clinton Initiative. Also, the launch of organizations like the Solar Thermal Federation of India (STFI) indicates that the industry is gearing up for a shift towards solar(Sharma, B D., 2011).

### 1.6. Energy Security

India needs to focus on developing its own sources of energy. The major energy sources, oil and coal, are imported in large quantities. Even with the development of nuclear energy, India

will be dependent on other nations for fuel. To sustain economic growth, to come out of the energy deficit situation and ensure that energy is available in every town and village, India must utilize its immense potential in solar energy (Sharma, B D., 2011).

The Indian solar industry has been maturing at a rapid clip, growing more than a hundredfold in four years to reach over 2.6 gig watts (GW) of installed capacity in 2014. Coupled with successful state-level policies in Gujarat and Rajasthan, the Jawaharlal Nehru National Solar Mission (Mission or NSM) has played a pivotal role in making the industry successful. Abundant policy instruments, such as feed-in tariffs (FiTs) and accelerated depreciation (AD), have been deployed at the state and national levels. These instruments have been vital to the rapid scale-up achieved by this industry so far and are now ready for adoption on a wider scale. Further, India's new government
has announced nationwide targets to harness solar power and enable every Indian home to run at least one light bulb by the year 2019( Council on Energy, Environment and Water

Natural Resources Defense Council, 2014).

Solar will become a crucial component of India's energy portfolio in the next decide- perhaps more so than it is in most other countries. We believe a solar market can develop fairly quickly going from nothing to several billion-dollar solar-centric firms within d decide( ATKearney, 2013).

**Renewable Energy Motivation in Iran**

The necessity of renewable energy in Iran can be classified in two reasons: 1) Environmental pollution and 2) More oil and gas export. In fact, the most important environmental problem in Iran is air pollution.

## 2. Iran's Scenario:

Iran is known as the second largest oil production member in Organization of Petrol Export Country (OPEC) with production near 3.5 million barrel oil per day and accounts for roughly 5% of global oil outputs. Also, Iran contains an estimated 812 Trillion Cubic Feet (TFC) in proven natural gas reserves, surpassed only by Russia in the world (Energy Information Administration, 2000).

Electric power generation installed in Iran is about 32.5 Giga Watts (GW) with more than 87% being from thermal natural gas fired power plant. Currently, Iran has five small nuclear reactors used for peaceful purposes. Nuclear and renewable energy will enable Iran to export more gas and oil and increase its revenue, since 80% of Iran's revenue is based on oil and gas export (Energy-Iran-Profile, 2001 ).

Iran is one of the main non-renewable energy producers in the world due to its plentiful fossil fuel resources. The use of natural gas and petroleum in transportation and industrial sectors has been developed vastly in Iran because of their low prices. As a result, the increasing rate of pollutant formation and depletion of non-renewable fuels have emerged as new challenges in the energy scenario of this country. Since Iran has plenty of fossil fuel resources, alternative fuel and renewable resources have not been taken into consideration seriously. Recently, controlling the unbridled fossil fuel consumption has become one of the main targets of the Iranian Government. A variety of natural resources in different regions of Iran can be applied as the main sources of renewable energy and also it can be considered as the supplementary energy in the energy mix policies.

### 2.1. Solar Energy in Iran

The average solar radiation for the whole of Iran is about 19.23 Mega joules per square meter, and it is even higher in the central part of Iran. The variation of radiation varies from 2.8 kWh/m2 in the south-east part to 5.4 kWh/m2 in central region. The calculations show that the amount of useful solar radiation hours in Iran exceeds 2800 hours per year.

For this reason, the first Photovoltaic (PV) site, with capacity of 5 kW DC was established in the central region of Iran in Doorbid village Yazd in 1993. Following this, in 1998, the second photovoltaic site with 27 kW AC capacity was installed in Hosseinian and Moalleman villages in Semnan 450 Km inland from Tehran. The capacity of these power plants has recently increased to 10 kW AC and 92 kW AC respectively. The power plant installed at Doorbid, works independently from the grid

system, while the one installed at Hosseinian and Moalleman, is connected to grid. It is worth mentioning that all equipment of these sites is made in Iran.

Use of solar energy to produce electricity in Iran is not very popular and the price of these type of sites is relatively high at about 3500 US$/kW. But there are some projects designed to use solar energy combined with thermal power plant to produce electric energy. These projects were under consideration since 1999. (Kazemi Karegar, H., Zahedia, A., Ohis V., taleghani, G. and Khalaji, M.)

### 2.2. **Iran's CO2 emission:**

Iran's CO2 emission is considerable and placed the country among the top ten emitting countries (Saboori, B. and A. Soleymani, 2011). Due to the fact that Iran is one of the biggest producers of oil and gas in the world, so that the most of CO produced is related to these sources of energy which are used in diverse industrial section such as power plants (Saeed, M., E. Roayaei, M. Jazayeri and et. al, 2012). As is illustrated in Fig. 3, Iran's CO emissions indicator is ever increasing.

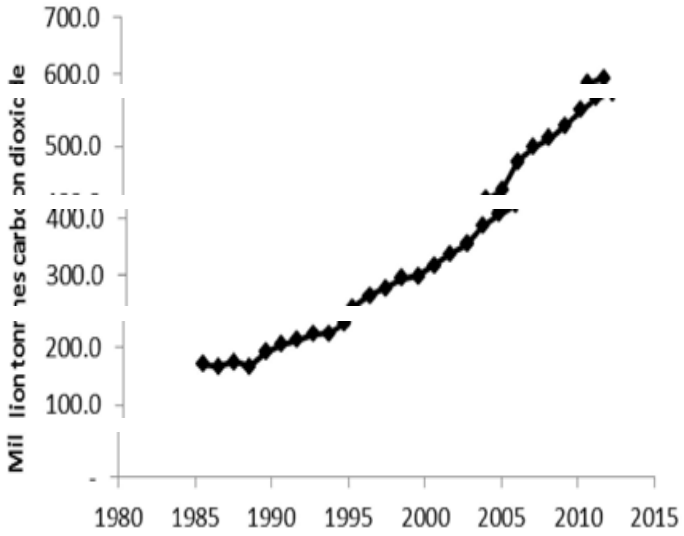


Fig. 3: Iran's CO emissions 2 (British Petroleum, 2012)

### 2.3. Energy Trade:

Energy trade means both buying and selling of energy commodities such as oil, coal, natural gas and electricity from where they are produced to where they are needed. Energy products are the main elements of world trade. According to statistics from the World Trade Organization (2009), world merchandise exports grew at an average annual rate of 12% between 2000 and 2008 (Sadorsky, P., 2011).

Iran's economy relies highly on its energy exports. Most of Iran's exports are oil and natural gas. In 2010, petroleum constituted 80 percent of all exports from Iran (Economy watch, 2010). Considering that the ratio of oil reserves to oil production amount in Iran is about 87 years and that up to the next 30 years, much of the energy of present buyers of oil will be supplied from renewable energies, it can be concluded that there is not a long time to convert oil wealth to a sustainable wealth. So, higher production of crude oil and its exports is quite economical. The best approach to Iran is development of domestic energy and non-oil economy and exporting more oil. Oil export revenues can be spent in long-term investment inside and outside the country. Industrial investment and technology promotion are the best strategy to use the oil capital, similar approach like Norway which develops its national economy with the profits of its oil revenues.

There are some barriers for development of renewable energies in Iran, which the most important are discussed as the followings:

- Inadequacy of specialists who are skilled in the field of solar energy.
- Poor knowledge about the importance of energy and inadequate advertisement by the government could result in less motivation by energy users and consequently the application of renewable energies could not gain significant rate.
- Insufficient funds to conduct projects.
- Slow process of contracting.
- Lack of sufficient and effective planning in this field by executive section.
- Insufficient legislative support and improper management.

Social acceptance of solar energy for growth and development of this energy is very important. The government must do a lot of effort to increase public awareness of the benefits and advantages of this energy source(Sajadi, S.M., S.M. Asadzadeh, V.M. Dalfard and et al., 2012.). It's the major barrier for solar energy and also renewable energy development in Iran.

## III. . CONCLUSION

It is clear that solar energy is becoming an important source of energy all over the World.

The study of solar energy in Iran shows that energy policy for mitigation of environmental impact and promote sustainable consumption has not yet been realized whereas in India Solar energy sector have been proposed many large projects. India is slowly gaining its prominence in the generation of solar power due to the comprehensive and ambitious state and the Centre's solar policies and projects and National Solar Mission. The finding of the study shows the bright picture as India's potential to be a solar power driven country of the world.

It is clear that private investments in technologies with long lifetimes and mid-term payback periods require stable economic conditions, clear objectives for the design of energy policies and the implementation of corresponding policy instruments. Paving the way towards a sustainable energy supply in Iran will not be successful without these prerequisites.

Lack of finances and public awareness and poor installation in Iran are the major hindrances to the ongoing adoption of solar energy in Iran. Whereas it can offer huge opportunities for social and economic development of Iran.

Cooperation of Officials of the Government of India and Iran in development of renewable energy sector particularly solar energy can create economic and environment opportunities For both countries, to secure Conservation of energy, environment protection. The two states can expand their relations in a number of key areas in solar energy and also in other renewable energy as a clean alternative to fossil fuels and create a healthier climate for future generations of human.

Some major recommendations for Iran to create more exploitation opportunities are as follows:

- Changing energy consumption and elevating public awareness and an information and training campaign at different levels.
- Government must provide financial support and encourage for private investors who plan to utilization solar energy power.
- Make public and government officials and the private sectors more and more sensitive to environmental issues.
- Solar energy could be made financially viable with government tax incentives and rebates.
- regulations to help private sector manufactures and researchers involved in the renewable energy projects particularly solar energy Make some practical.
- Create plans to reduce greenhouse gas emissions in the industry.

## REFERENCES

1. Amer, M. and T.U. Daim, 2011. Selection of renewable energy technologies for a developing county: A case of Pakistan. Energy for Sustainable Development, 15: 420-435.
2. ATKearney. (2013). Solar Power and India's Energy Future.
3. Badran O O. Study in industrial applications of solar energy and the range of its utilization in Jordan. Renewable Energy 2001; 24:485–490.
4. Council on Energy, Environment and Water Natural Resources Defense Council. (August 2014). Reenergizing India's Solar Energy Market through Financing, report on international: INDIA.
5. Economy watch, (2010, Jun 30). Iran Export, Import & Trade [online]. Available: http:// www.economywatch.com/world_economy/iran/exp ort-import.html/
6. EIA, 2009. International energy outlook. DOE/EIA- 0484(2009), energy information administration. U.S. Department of Energy.
7. Energy Information Administration, "Iran energy oil information", Feb. 2000.
8. Energy, "Power Projects and Services Market in Iran", Energy-Iran-Profile, Feb. 2001.
9. Ernst & Young LLP. (Status and outlook 2013). Mapping India's Renewable Energy growth potential, p. 4.
10. Gevorg Sargsyan et al., Unleashing the Potential of Renewable Energy in India (Washington, DC: World Bank,

2011), Http://www.esmap.org/sites/esmap.org/files/ IndiaStudyWEB_Final.pdf.

11. Hafshejani, M. K., Baheri, A., Ojakeh, M., Sedighpour, A., Arad, A., Choopani, S. (2012). Impact of solar energy application on warming, health caring and pollution prevention in Iran. *Life Science Journal*, 9(4), p. 1849.
12. Hair, J. F.; Brush, R. P.; Ortinau, D. J. 2000. Marketing Research: A Practical Approach for the New Millennium. United States: McGraw-Hill Higher Education.
13. Hiremath, R.B., B. Kumar, P. Balachandra, N.H. Ravindranath and B.N. Raghunandan, (2009). Decentralised renewable energy : Scope, relevance and applications in the Indian context. Energy for Sustainable Development, 13: 4-10.
14. Ibid.
15. Jefferson, M., 2006. Sustainable energy development: performance and prospects. Renewable Energy, 31: 571-582.
16. Karakosta, C. and D. Askounis, 2010. Developing countries' energy needs and priorities under a ustainable development perspective : A linguistic decision support approach. Energy for Sustainable Development, 14: 330-338.
17. Krishna, C.; Sagar, A. and Spratt, S. (2014, forthcoming) *The Political Economy of Low-carbon Investments: Insights from the Wind and Solar Power Sectors in India*, IDS Working Paper, Brighton: IDS.
18. Kazemi Karegar, H., Zahedia, A., Ohis V., taleghani, G. and Khalaji, M., Wind and Solar Energy Developments in Iran.
19. Lok Sabha, Unstarred Q.no. 866-Shortfall in electricity supply, August 13. 2013.
20. Lok Sabha, Unstarred Q. No. 399-village Electrification, December 13, 2012.
21. Lok Sobha, Unstarred Q. No.1968-Investment in Renewable Energy Sector, August 3, 2013.
22. Meisen, P. (October 2006). Overview of Renewable Energy Potential of India. *Global Energy Network Institute (GENI*), p.11.
23. "More ultra mega solar plants on anvil", *The Hindu*, November 11, 2013, http://www.thehindu.com/business/Industry/more-ultra-mega-solar-Plants-on-anvil/article5339822.ece.
24. Press Information Bureau, Government of India, "Largest Solar Power Project in the World to Be Set Up in Rjisthan 1ST Phase to Be Completed in 3 Years-Praful Patel", September 20, 2013.
25. PTI, "India will be largest source of oil demand growth after 2020: International Energy Agency," Economic Times, December 4, 2013, http:// articles.economictimes.indiatimes.com/2013-12-04/news/44757431_1_oil-demand-growth-ies-world-energy-outlook.
    a. http://pib.nic.in/nesite/erelease.aspx?relid=99512.
26. Saboori, B. and A. Soleymani, 2011. CO 2 emissions, economic growth and energy consumption in Iran : A co- integration approach. International Journal of Environmental Sciences, 2: 44-53.
27. Sadorsky, P., 2011. Trade and energy consumption in the Middle East. Energy Economics, 33: 739-749.
28. Saeed, M., E. Roayaei, M. Jazayeri, M. Saboormaleki, M. Minaei and M. Emadi, ( 2012). Database of CO2 Emission Sources and Analysis of Geological Structures for a Carbon Sequestration Project in Iran. in SPE Middle East Health, Safety, Security and Environment Conference and Exhibition. British Petroleum (BP), 2012. Statistical energy review 2012 [Excel format file]. Available: www.bp.com/ liveassets/bp_internet/globalbp/ globalbp_uk_english/reports_and_publications/st atistical_energy_review_2011/STAGING/local_ass ets/spreadsheets/statistical_review_of_world_ener gy_full_report_2012.xlsx/.
29. Sajadi, S.M., S.M. Asadzadeh, V.M. Dalfard and M.N. Asli, 2012. A new adaptive fuzzy inference system for electricity consumption forecasting with hike in prices. Neural Comput & Applic.
30. Shukla, P. & Ranjan Guru, R., May 2007. Renewable Energy and Energy Efficiency Status in India, Report compiled by ICLEI South Asia.
31. B D, Sharma. (February, 2011). Performance of Solar Power Plants In India. *Central Electricity Regulatory Commission New Delhi*, p.7.
32. Sukhatme S. Solar energy, McGraw-Hill, New Delhi 1997.
33. U.S. Energy Information Administration, full report, India, Last Updated: June 26, 2014.
34. WCED-World Commission on Environment and Development, 1987. Report of the World Commission on Environment and Development: Our Common Future. Oxford, UK: Oxford University Press.
35. Winkler, H., 2007. Energy policies for sustainable development in South Africa. Energy for Sustainable Development, 11: 26-34.
36. World Energy Resources, 2013 Survey, Conseil Mondial DE L'Énergie for sustainable energy, Published by: *World Energy Council Registered in England and Wales*.